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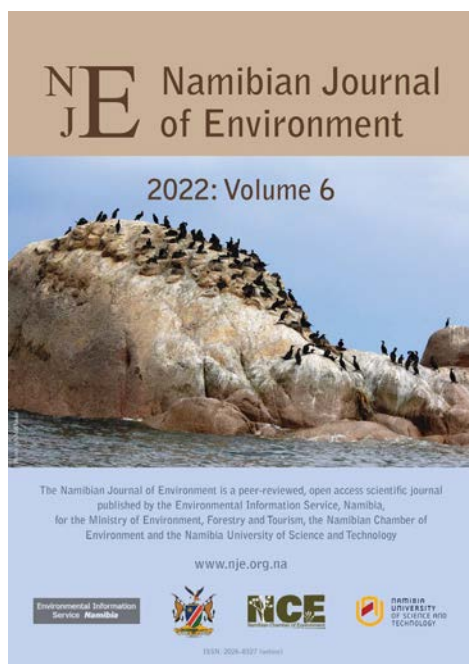
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SECTION A: RESEARCH ARTICLES

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An analysis of trophy size trends in popular hunting species in Namibia over five years

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ABSTRACT

Within the last twenty years, Namibia has developed a leading alternative model of biodiversity conservation, largely due to its Community-Based Natural Resource Management (CBNRM) programme and its allocation of large areas of land towards biodiversity conservation. The CBNRM model is based on the rights of communal conservancies to benefit from the wildlife that is present on their land; one such right is to receive meat and revenue from trophy hunting. However, the marketability of desirable trophy animals is dependent on the consistent presence of quality trophy individuals within local wildlife populations, which can, through over-hunting, lead to an unsustainable operation. This study considered trends in numbers, locations and sizes of trophies hunted over a five-year period. Three sought-after high-value species, namely buffalo (*Syncerus caffer*), roan (*Hippotragus equinus*), and sable (*Hippotragus niger*), along with the iconic and frequently hunted trophy species kudu (*Tragelaphus strepsiceros*), were considered in this study. Buffalo and roan trophy sizes showed signs of a non-significant increase over time. Sable trophy measurements indicated a non-significant negative size trend, while kudu trophy measurements significantly declined across Namibia over the 5 years. It is speculated that large kudu bulls have become less common, possibly due to a combination of overhunting and the impact of rabies. Most roan, sable and kudu were hunted on freehold farms, while buffalo were exclusively hunted in national parks and communal conservancies in the north-east. Despite commercial game farmers breeding roan and sable selectively, there were no significant positive trends in trophy size on freehold farms. This study paves the way for further research into the effect of environmental and socio-economic variables that could be factored into determining the influence on trophy measurement trends, and for more effective monitoring and management of popular hunting wildlife species.

Keywords: buffalo; hunting; kudu; Namibia; roan; sable; trophy

INTRODUCTION

Hunting has been recognised as a useful natural resource management tool across the globe in terms of its economics, its ecological influences, and its sociological benefits (Gallo and Pejchar 2016). Trophy hunting can be a viable economic activity that adds value to the presence of wildlife; a fact made clear by trophy hunting drawing more income per client than non-consumptive tourism (PACEC 2006; Lindsey *et al.* 2007; Munn *et al.* 2010). The reinvestment of hunting revenue into wildlife protection and the contribution towards anti-poaching efforts by hunters has contributed towards species conservation in many of the countries where sport hunting is practiced (Lindsey *et al.* 2007; Arnett and Southwick 2015) and considerably so in Namibia (Humavindu and Barnes 2003; Erb 2004; Schalkwyk *et al.* 2010).

Ecologically, hunting can have a lesser impact on the environment, when compared with other development opportunities, in terms of disturbance, fossil fuel use, and infrastructure development; also, trophy hunting (if well managed) utilises no more than 2-5% of the male population in a designated

area, making it mostly a sustainable industry (Lindsey *et al.* 2007). To take advantage of the economic opportunity that trophy hunting offers, private landowners have re-established and protected wildlife species which were previously eradicated (Bond *et al.* 2004; Bothma *et al.* 2016). A great determinant of the success of the trophy hunting industry, from a financial point of view, is the variety of species on offer, along with high quality trophies (Von Brandis and Reilly 2007). The creation of measuring systems and record books has led to competitiveness within the trophy hunting community, as some hunters strive to find a large trophy animal that might be recorded in the Rowland Ward or SCI Record Books.

In Namibia specifically, wildlife population numbers in Kunene and Zambezi Regions have increased due to the incentives that were created for sustainable wildlife utilisation by residents on communal land since the 1990s (Jones and Weaver 2009; MET/NACSO 2020). As a means of unlocking wildlife value to communities, trophy hunting is permitted, which generates the highest cash revenue to communal conservancies throughout the country (MET/NACSO 2020).

There are however growing negative sentiments towards trophy hunting, which are based mainly on the perceived threats towards the populations of rare or endangered species; these negative sentiments are further compounded by concerns around the ethics of sport hunting of any animal (Lindsey *et al.* 2007; Di Minin *et al.* 2016; Sheikh and Bermejo 2019). Besides concerns regarding the ecological impacts of trophy hunting, there are additional concerns regarding corruption in developing nations that might siphon off funds (from trophy fees) from their intended beneficiaries (Packer *et al.* 2011).

Multiple studies have been conducted to ascertain the sustainability of hunting and its influence on trophy size. A study on roe deer (*Capreolus capreolus*) in the Baltic region (Balčiauskas *et al.* 2017) concluded that smaller trophy size in certain areas could be attributed to the hunting of individuals that had not yet matured, which motivated the need for a minimum age limit. A study of bighorn sheep (*Covis canadensis*) in Arizona (Pigeon *et al.* 2016) attributed a decline in trophy sizes to the hunting of younger individuals with faster-growing or longer horns, or overall overharvesting (Festa-Bianchet *et al.* 2004). Similarly, a 40-year study of trophy size trends of Stone's sheep (*Ovis dalli*) in Canada indicated that there was a decline in early horn growth and males harvested in areas where there was a strong selective hunting pressure (Douhard *et al.* 2016).

Various studies of trophy hunting (with a specific emphasis on trophy sizes and trends) and its effects, especially upon wild ungulate species, have been conducted in Africa. One study in Tanzania (Wilfred 2012), using data from 2006 to 2010 showed that mean trophy size, with the exception of warthog (*Phacochoerus africanus*), showed only slight changes, with most species remaining just above the threshold of acceptable trophy size. Studies within the Selous Game Reserve of Tanzania confirmed that trophy size of buffalo, lion (*Panthera leo*), leopard (*Panthera pardus*), elephant (*Loxodonta africana*), and hippo (*Hippopotamus amphibius*) had significantly declined largely due to unrestricted trophy hunting since poaching incidents were relatively few (Songorwa and du Toit 2007). A similar study in Zimbabwe (Crosmary *et al.* 2013), determined that the trophy sizes of commonly hunted species revealed some

form of decline; but a 6% decrease in sable could mainly be attributed to hunting pressures associated with their high-value status. Another study in Zimbabwe's Sengwa Wildlife Research Area revealed that the trophy size of elephant, buffalo, and lion had declined (Patmore *et al.* 2015). With buffalo, roan, sable, and kudu being high value and sought-after trophy hunting species in Namibia, trophy size measurements for these species were chosen in this study. The study considered numbers and locations of trophy hunts, and trophy size trends over a five-year period between 2011 to 2015.

METHODS

Study area

The initial analysis of the database of trophy records primarily focused on the communal conservancies and national parks situated within the north-eastern regions of Namibia (i.e., the Namibian component of the Kavango-Zambezi Transfrontier Conservation Area) (MET/NACSO 2020). However, since the focus of the study includes the hunting of animals on all available wildlife land-types, freehold farmland was included as a part of the study (Figure 1).

The hunting of the four study species - buffalo, roan, sable, and kudu - within national parks is very limited and takes place mostly within the Bwabwata National Park and the Waterberg Plateau Park (where all four species are present). Communal conservancies do have higher quota allocations in comparison to national parks, but most of the hunting of roan, sable, and kudu takes place on privately owned farmland.

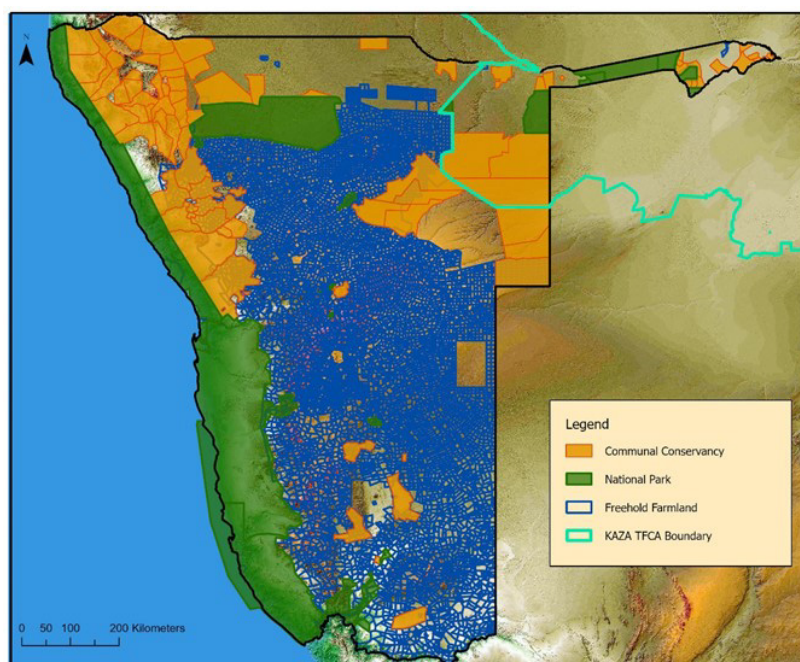


Figure 1: Land use in Namibia, subdivided into national parks, communal conservancies and freehold farmland. Target conservancies were located within the KAZA TFCA boundary.

Buffalo occur almost exclusively in the north-eastern national parks and communal conservancies; with Waterberg Plateau Park being the only exception (Kasiringua *et al.* 2017). Roan and sable occur naturally in the north-eastern national parks and communal conservancies and have been introduced to freehold farmland for hunting and live sales (Blackmore 2017). Kudu are present naturally throughout the country (Skinner and Chimbimba 2005).

Data source

Data were sourced from the Ministry of Environment, Forestry and Tourism's database of annual hunter's return forms. The forms were gathered during 2011-2015, containing details of 11,665 data entries for trophy hunts of the four species considered in this study. The forms are required to be completed by law (Nature Conservation Ordinance 1975) following each successful trophy hunt. Each of the return forms gives specific information regarding the locality of the hunt, land tenure type, the year, the nationality and name of the hunter, the permit number, the species hunted and the measurements of the trophy hunted.

There are three official methods for trophy measurement in Southern Africa which can be used to determine trophy size (van Rooyen *et al.* 2016).

These are the Rowland Ward system, the Safari Club International (SCI) system, and the South African system. Each measurement system makes use of specific measurements such as horn length, horn circumference and skull size to produce a trophy score (Figure 2). Any trophy which is considered a record-sized trophy can be added to either the Rowland Ward or the SCI record books. The publication of these records is considered essential in marketing a region, as international hunters are more likely to hunt in areas where the largest trophies were shot (du Toit *et al.* 2016).

The SCI measuring system (Schwabland and Barnhart 2016) is the most commonly used system and forms the foundation for hunter return forms submitted to the Namibian Ministry of Environment, Forestry and Tourism (Schwabland and Barnhart 2016). Records using this system were used in the analyses for this study.

To investigate whether the perception of hunting trends by hunters corresponded with the data analysis, interviews were conducted with 38 professional hunters, who have operated within several of the communal conservancies and freehold farms. Most questions were directed towards understanding their perceptions on the trends in the trophy size and to compare their perceptions with the quantitative analysis of the trophy measurements.

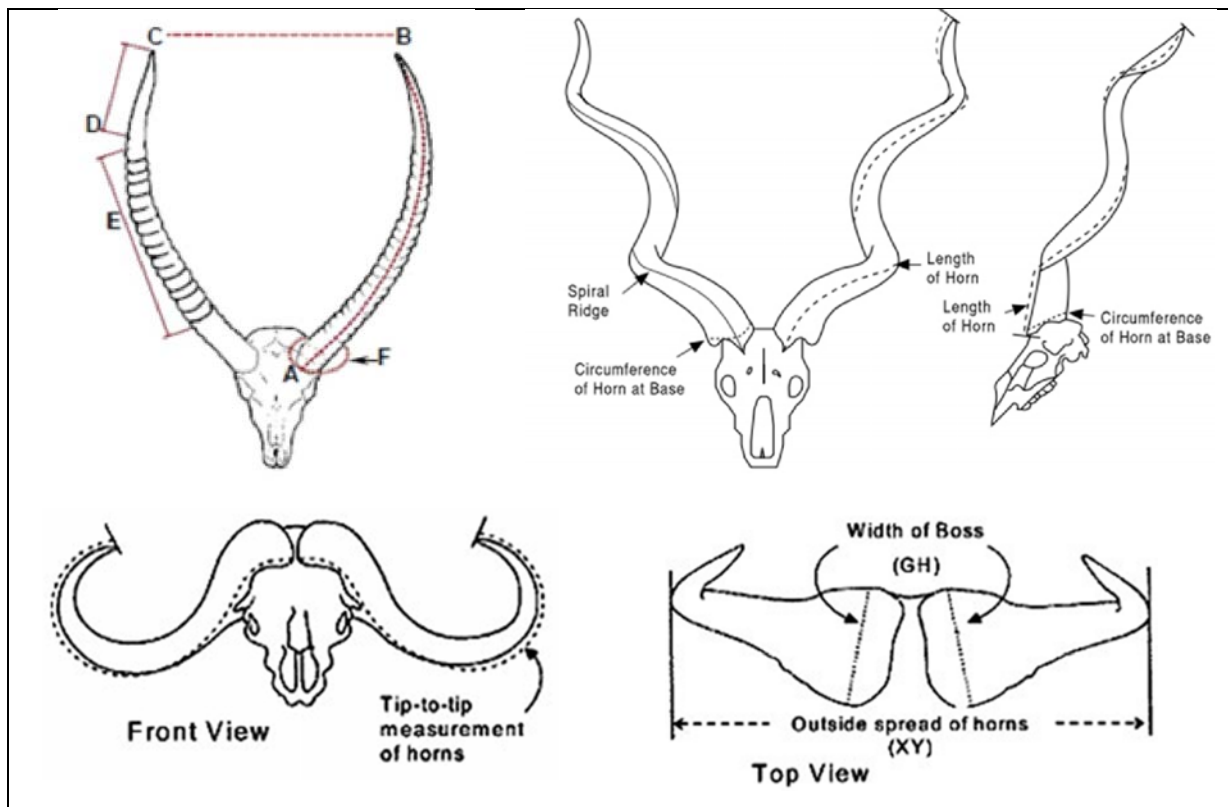


Figure 2: SCI measuring system for simple-horned antelope, spiral-horned antelope, and African buffalo (Schwabland and Barnhart 2016).

There are currently over 350 registered members of NAPHA (NAPHA, 2019); hence the sample size of 11% was considered adequate since this was not the primary focus of the overall study.

Data preparation and analysis

For each of the four study species, a quantitative assessment of annual trends of the number of animals hunted was conducted. The Kruskal-Wallis Analysis of Variance (ANOVA) test (Katz and McSweeney 1980) was used to test for any statistical significance in the annual variation per species using Statistica® Version 10 for Windows (StatSoft 2011); but only after the Shapiro-Wilks test for normality (Shapiro *et al.* 1968) was conducted on the total scores. None of the data analysed were normally distributed.

Any statistical analysis of trophy size that yielded a significant difference ($p > 0.95$) for a dataset was subsequently tested using the Tukey post hoc test (Tukey 1949) to determine specific significance between variables.

RESULTS AND DISCUSSION

Numbers hunted

Table 1 presents the numbers of each species hunted. Across the study area, buffalo were the only species hunted mostly in communal conservancies with a total of 237 out of 330 individuals (Figure 3a) being trophy hunted during the years 2011-2015. In the north-eastern communal conservancies, the Bwabwata National Park, and the Waterberg Plateau Park, buffalo accounted for 21.95% of all trophies. Though buffalo are the 25th most commonly hunted of all species within Namibia, they are considered to be one of the most popular trophy animals to hunt in other African countries, especially among American hunters (Lindsey *et al.* 2006), due to it being classed as a dangerous game species (Lindsey *et al.* 2007), with considerable adventure and prestige being associated with a buffalo hunt (Gandy and Reilly 2004). Private ownership of buffalo is prohibited

within Namibia to prevent disease transfer to cattle in accordance with European Union (EU) beef import requirements (Tekleghiorghis *et al.* 2016). Therefore, the national parks and communal conservancies have an exclusive market for hunting of this species.

Roan, alongside sable, tends to be a popular trophy species due to its attractive trophy qualities and relative rarity (Van der Merwe *et al.* 2004). Roan and sable populations have recovered from historical lows in the 1980s (Harrington *et al.* 1999; McLoughlin and Owen-Smith 2003; Owen-Smith *et al.* 2012) largely due to being intensively bred by commercial farmers for lucrative auction prices and hunting demand for the species (Bothma *et al.* 2016; Palazy *et al.* 2012; Rethman *et al.* 1996; Van der Merwe and Saayman 2005). This was followed by a period when both species were bred selectively for increased horn sizes mostly in South Africa (Nel 2015; Taylor *et al.* 2020), but also in Namibia (Blackmore 2017). As an example, during the study period, a roan trophy bull was sold for N\$ 1,000,000 at a commercial wildlife auction (New Era 2015). Roan is still regarded as a rare antelope in Namibia (Havemann *et al.* 2016; IUCN 2019b; Martin 2003), even though the recent range expansion onto freehold farmland has made the species a relatively common sight throughout Namibia. Roan was the 34th most commonly hunted species during the study period and was the 16th most popular animal to hunt in north-eastern parks and conservancies (mainly within Waterberg Plateau Park and Nyae Nyae Conservancy).

In comparison to other high-value species, roan trophy hunt quotas were conservatively allocated within the north-eastern communal conservancies of Namibia. There was a slight decrease in the number of roan allocated on trophy hunting quotas within communal conservancies coinciding with an increase in the number of roan hunted - with the total amount not exceeding the newly adjusted quotas (Figure 3b), probably influenced by population counts and subsequent quota readjustments for those respective years. In 2012, the estimated number of roan in

Table 1: Numbers of the study species hunted according to land-use type.

	National Park					Communal Conservancy					Freehold Farmland				
	2011	2012	2013	2014	2015	2011	2012	2013	2014	2015	2011	2012	2013	2014	2015
Buffalo	22	18	16	16	21	28	46	47	53	63	N/A	N/A	N/A	N/A	N/A
Roan	2	3	2	3	4	5	8	9	8	9	12	16	22	12	20
Sable	3	8	5	7	8	1	0	5	1	1	44	51	58	47	64
Kudu	3	7	9	10	12	41	50	45	28	37	2,222	2,243	2,140	1,540	1,446
Total	30	36	32	36	45	75	104	106	90	110	2,278	2,310	2,220	1,599	1,550

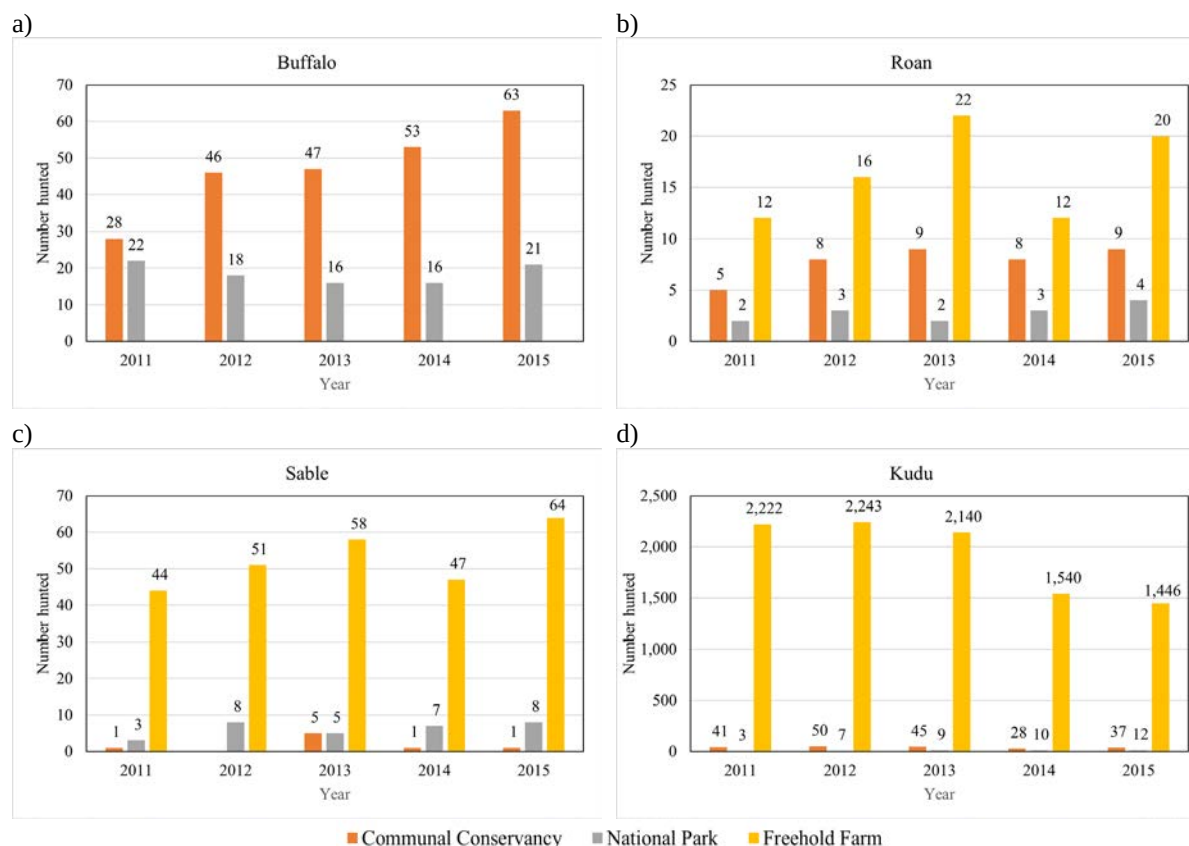


Figure 3: Total number of a) buffalo, b) roan, c) sable, and d) kudu hunted nationally during the study period on each land use. Noticeably, there was an increase in the number of buffalo and sable hunted within communal conservancies and freehold farms respectively. There was a decline in the number of kudu hunted during the study period.

Bwabwata National Park and the Zambezi conservancies were 1,789 (NACSO 2012a) and in 2015 it was 1,192 (NACSO 2015a, 2015b).

Sable was not as commonly hunted during the study period, both nationally (26th on the list of hunted animals within Namibia) and within the north-eastern national parks and communal conservancies (23rd on the list of hunted animals in north-eastern parks and communal conservancies). This contrasts with other countries where the popularity of sable-hunting (i.e. Zambia and Zimbabwe) is unquestionably high (Crosmar *et al.* 2013; Lindsey *et al.* 2007). Generally, the low numbers hunted in communal conservancies can be attributed to the limited availability of suitable habitat (Bothma *et al.* 2016; Martin 2003; NNF 2008) and consequently the low population numbers. Since intensive breeding of sable for huntable animals became popular later than in South Africa, far fewer individuals were hunted on Namibia's commercial hunting farms. Intensive breeding is also not as popular as in South Africa, since Namibia mostly markets hunting of animals in extensive natural landscapes as opposed to small land units with artificially bred specimens (Nel 2018).

Despite the increase in communal conservation land in the north-east, sable hunting did not increase

proportionally. This is possibly due to most new conservancies being proclaimed on the Chobe East floodplains while sable tends to prefer open woodland (Skinner and Chimbimba 2005). The quota being allocated is probably a response to the number of sable observed on game counts (estimated at 1,494 in 2012 and 2,355 in 2015) (NACSO 2012a, 2015a, 2015b) or via other means of counting methodology (e.g. aerial wetland surveys and fixed foot patrols) (MET/NACSO 2020). There was no observable trend in the number of sable hunted (Figure 3c) since hunting within communal conservancies and parks was somewhat sporadic, while there was a noticeable increase in the number hunted on freehold farmland.

In terms of the desirability of kudu as trophy animal, it was the 4th most commonly hunted trophy animal in Namibia, preceded only by gemsbok, warthog, and springbok. The desirability of kudu as a huntable species in Namibia is probably linked to it being common and the appeal of the large horn size that sets it apart as a charismatic species (Crosmar *et al.* 2013), and its distribution across most parts of the country (Mendelsohn *et al.* 2002).

The number of kudu made available for trophy hunting within communal conservancies across the country increased despite the declining population

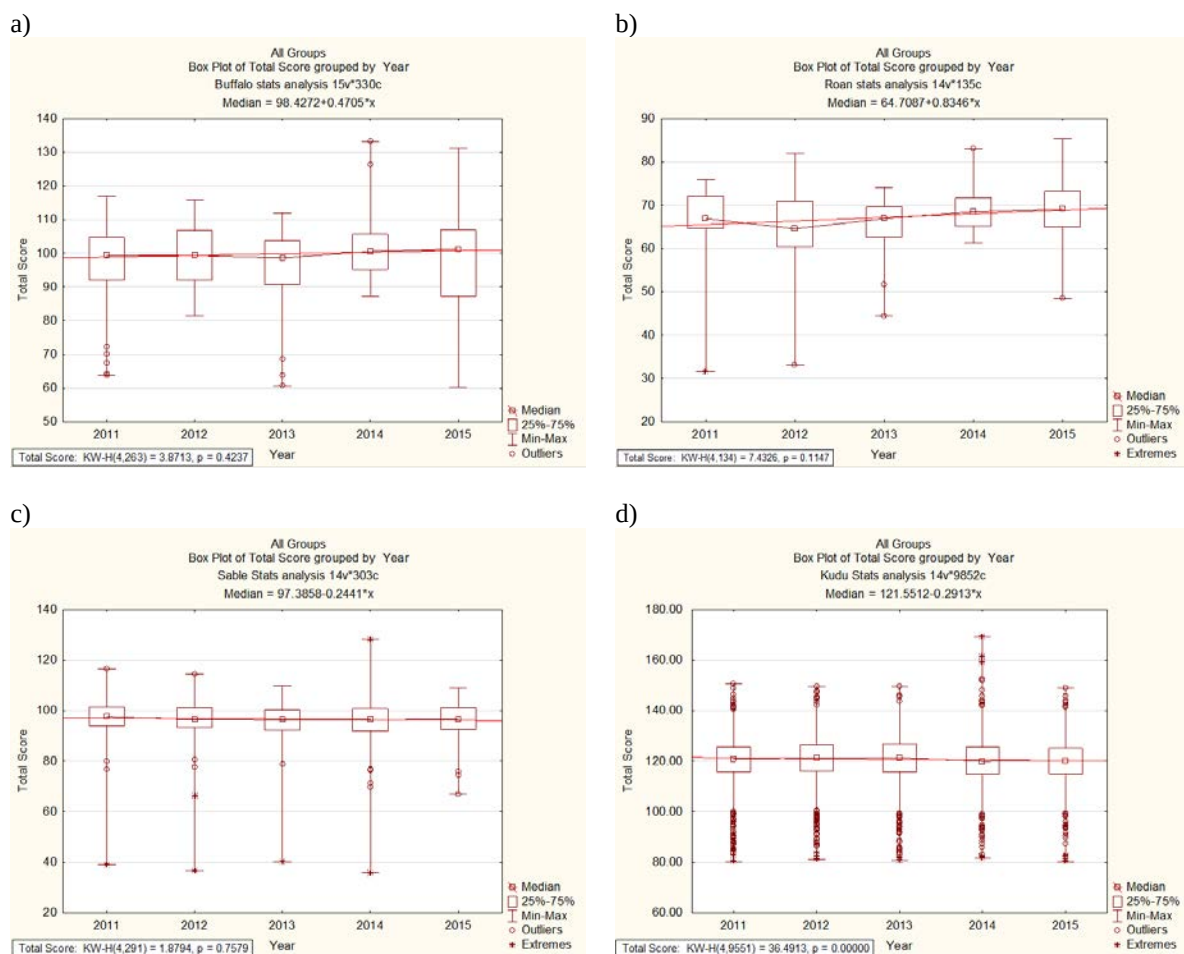


Figure 4: Trophy size over five years (2011-2015) in all land-use types for a) buffalo, b) roan, c) sable, and d) kudu. There were no statistically significant trends in trophy size for buffalo, roan, and sable over the study period. Kudu showed a statistically significant ($p < 0.05$) decline in horn size.

estimates for the north-western and north-eastern communal conservancies (Figure 3d), nevertheless, the percentage of the total quota for kudu was less than 5% of the estimated population (NACSO 2015a, 2015c). There was a 16.4% decrease in kudu numbers based on the 2012 and 2015 game counts in north-western (NACSO 2015c, 2012b) and north-eastern Namibia (NACSO 2015a, 2015b, 2012a). However, it is evident that kudu is a highly utilised and popular species for trophy hunting in Namibia (Lindsey *et al.* 2007; MacLaren *et al.* 2019). The endemic presence of rabies within kudu and the ease of transmissibility within kudu herds has episodically caused a substantial decline in the kudu population in some areas of Namibia (Scott *et al.* 2012). During the study period, 17% ($n = 271$) of the reported mammal rabies cases were kudu, preceded only by cattle ($n = 472$) and domestic dogs ($n = 494$) (Rainer Hassel, personal communication, 2018).

Three of the four species showed stable or increasing trophy sizes over the five-year period (Figure 4). Considering the principle that a reduction in trophy sizes over time may indicate overhunting of trophy

animals by selectively removing animals with desirable traits (Von Brandis and Reilly 2007), this study indicates no overhunting of buffalo, roan or sable. This will allow for a sustained marketability of these species for international hunters.

Trophy size trends

Kudu

Based on the statistical significance ($p < 0.05$) presented by the kudu data (Figure 4d), (Table 2) kudu trophy sizes were significantly larger in 2012 and 2013 than in 2014 and 2015. This suggests an overall decline in trophy size.

The experience of wildlife veterinarians suggests that rabies affects both kudu bulls and cow-calf herds equally (Tübbesing 2016); which suggests that availability of larger trophies will be more severely impacted with recurring rabies outbreaks (affecting the trophy bulls and influencing the reproductive rate of the population).

Buffalo

Despite the increased year-on-year trends for numbers of buffalo hunted (Figure 3a), overall trophy size was found to be stable or increasing (Figure 4a). This may be influenced by the fact that although the resident population of buffalo in the Zambezi is approximately 5,000 (Chase 2007; NACSO 2015a), in comparison to northern Botswana's estimated population of 40,000 buffalo (Chase 2017), there is a high level of dispersal and migration between Botswana and Namibia (Naidoo *et al.* 2014); evidenced by a collared buffalo that migrated over 100 km between the two countries in a one-year period. The total source population for buffalo is therefore extremely large and hunting at current levels is unlikely to influence trophy sizes. An advantage is that most communal wildlife areas are unfenced open systems where immigration and emigration of wildlife can occur uninterrupted and where the genetic diversity is large as a result (Naidoo *et al.* 2014; MET/NACSO 2020).

However, it should be noted that even though the appearance of trophy measurements during the study period indicates a non-significant ($p > 0.05$) positive growth trend, care should be taken to assess whether the measurement size is linked to the age of the individual animals – the increase in larger trophies might be a product of the hunting of younger individuals or bulls that are in their prime (Gandy and Reilly 2004; Jeke *et al.* 2019) since horn sizes tend to decrease after 67-72 months of age (Lepori *et al.* 2019).

Since buffalo horn size is often correlated to the openness of the environment and the nutrition available (du Toit 2016), along with the health of the individual animals (Ezenwa and Jolles 2008) the largely unfenced system of north-eastern Namibia, Zambia, Botswana, and Angola, known as the Kavango-Zambezi Transfrontier Conservation Area (KAZA) (Naidoo *et al.* 2014), will likely house a healthy number of trophy animals.

The increase of the average trophy measurements within the communal conservancies and the national parks stands in contrast to what is being observed elsewhere in Africa (e.g. Zimbabwe and Tanzania) (Wilfred 2012; Ngorima and Mhlanga 2015).

Roan

There was a marginal, but statistically non-significant, increase in roan trophy size over the five-year period (Figure 4b). Roan hunts were mostly on freehold farmland (60.7% throughout the study period), and it was expected that the increase would be more noteworthy since roan are one of the most popular intensively bred species on freehold farmland, where selection for animals with large horn sizes is practiced commonly (Blackmore 2017; Nel

Table 2: Tukey post hoc test for the kudu national trophy size data for the years 2011-2015. Statistical significance for the corresponding years is indicated as follows: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.005$.

Year	{2011} (120.35)	{2012} (121.02)	{2013} (120.90)	{2014} (119.98)	{2015} (119.84)
2011		0.0746	0.2263	0.6976	0.3998
2012	0.0746		0.9904	0.0026 ***	0.0005 ***
2013	0.2263	0.9904		0.0129 *	0.0028 ***
2014	0.6976	0.0026 ***	0.0129 *		0.9916
2015	0.3998	0.0005 ***	0.0028 ***	0.9916	

2015). Roan trophies were only marginally larger on freehold farmland than in communal conservancies. Although the largest trophies were consistently hunted in the national parks where they occur naturally, there was a significant decline in the sizes of roan trophies in the national parks.

Sable

There was an overall decline in the trophy size for sable (Figure 4c), but based on the further in-depth statistical analysis, there was a steeper decline in the sable trophy horn measurements in the national parks than in any of the other land-uses – however, there was no significant difference ($p > 0.05$) in sable trophy sizes over the five-year period. If trophy size is therefore truly an indication of population health, the trends might be similar to those of the greater Hwange conservation area, where the sable population did not seem to thrive in the national parks (Crosmarby *et al.* 2015). Some studies mention that sable is reliant on open woodlands and grasslands for reproduction (Bothma *et al.* 2016; Capon 2012; Crosmarby *et al.* 2015; Skinner and Chimbimba 2005), but, if sable are under hunting pressure, they will relocate to the safety of closed woodlands where they are difficult to locate and hunt (Ndaimani *et al.* 2014).

Hunter perception

Hunter perception seemed to closely mirror the quantitative trends found in Figures 4a to 4d within conservancies and national parks (Figure 5). Of the hunters questioned ($n = 15$) 26% felt that buffalo trophy size was increasing, 47% claimed that the trophy size trends were stable, and the remaining 26% felt that trophy sizes were decreasing. In terms of roan, 38% of the hunters felt that the trophy sizes had increased, and the remaining 62% perceived that trophy sizes were stable. For sable, 25% of the hunters felt that the trophy sizes were increasing and

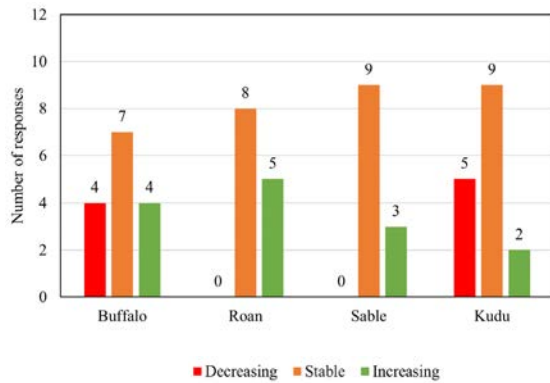


Figure 5: Hunter perceptions of trophy size within communal conservancies and national parks show mostly stable to increasing trophy size trends for all four species.

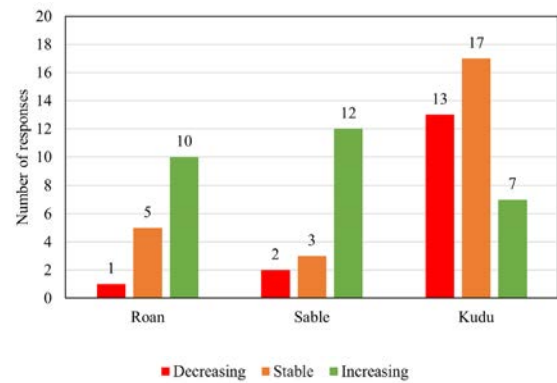


Figure 6: Hunter perceptions of trophy size within freehold farmland show mostly stable to increasing trophy size trends for roan and sable and stable to decreasing trophy size trends for kudu.

the remaining 75% claimed that the trophy sizes were stable. In contrast to the other species, it was felt by only 13% of the hunters that the kudu trophy sizes had increased, 56% believed that the trophy sizes were stable, and the remaining 31% perceived that the trophy sizes had decreased.

On private land hunter perception tended to over-estimate trophy size trends for sable over time (e.g. Figure 4c versus Figure 6). For buffalo, roan, and kudu, the perceived trends were similar to the reported measurements.

CONCLUSION AND RECOMENDATIONS

This study indicated that trophy measurements for buffalo and roan were stable to increasing. This was found across all areas indicating that hunting of these species for the study period was indeed sustainable. Sable trophy measurements declined mostly in national parks, which indicates that adaptive management is needed to ensure the sustainability of hunting sable in these areas. Of most concern is the significant decline in kudu trophy sizes, where the combination of rabies and overhunting seems to be affecting the numbers of large trophies and possibly the national population of the species negatively.

The largest buffalo trophies were found in the north-eastern conservancies (specifically Balyerwa) and Bwabwata National Park – since this is where the species is commonly hunted in Namibia and where it occurs in larger numbers. For roan, the largest trophies for Namibia were recorded mainly on freehold farmland. In terms of sable, the reported top trophy was recorded in Bwabwata National Park, but a majority of the largest trophies were hunted on freehold farmland. The largest trophies for kudu were all hunted on freehold farmland, mainly in central Namibia.

The study also found that hunters' perceptions of trophy sizes are a good indication of trends, indicating that their opinions are important to use when considering trophy hunting sustainability. Regular structured surveys should therefore be conducted in addition to the trophy return forms to provide input into adaptive setting of trophy quotas for the future.

Additional studies of age-related trophies would provide additional value in assessing the true value of conservation hunting (hunting post-reproductive males rather than the males with the highest trophy score).

This study mainly sought to discover the trends in the high-value species of the north-eastern regions of Namibia, and the possible influences on these trends between the different land uses. More detailed studies should be conducted to link the trends with other important variables (e.g. rainfall, trends in poaching, the vegetation type that allows for visibility, fire frequency, trophy trends in other native ranges, the human population density in the local and international ranges, the density of large carnivores in home ranges of the study species, the hunting experience of the professional hunters involved, the movement of species in open systems, and the economic drivers in trophy desirability).

The impact of commercial farmers relocating sable and roan to private farms on unsuitable habitat and in areas where they did not previously occur needs further investigation. This impact relates to the impact on trophy sizes with selective breeding, the impact on habitats and the reputational impact of hunting trophies in unnatural conditions, which contrasts with Namibia's reputation of natural hunting conditions.

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